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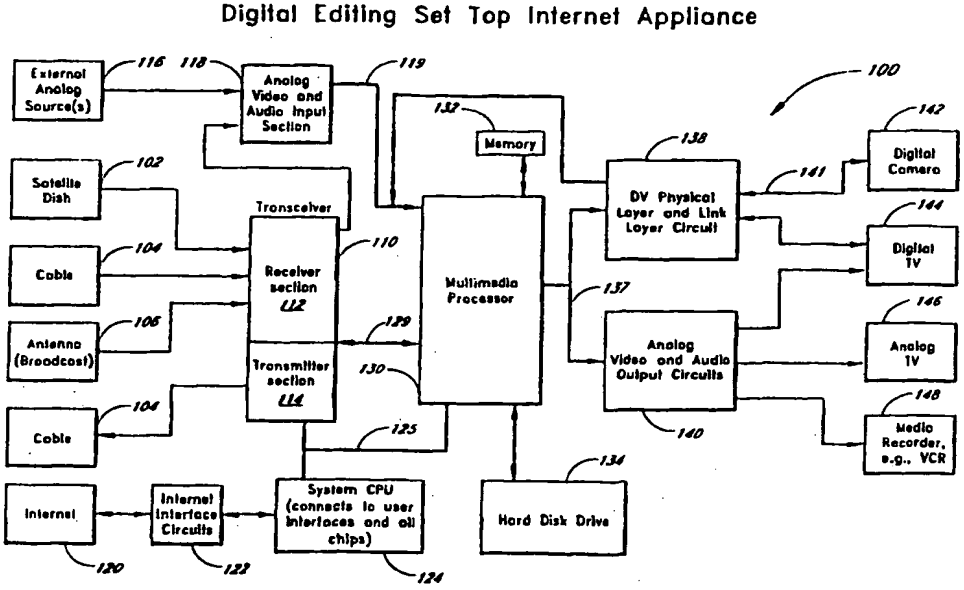
(54) Title: NON-LINEAR MULTIMEDIA EDITING SYSTEM INTEGRATED INTO A TELEVISION, SET-TOP BOX OR THE LIKE

(57) Abstract

A non-linear media editor may be integrated into an analog or digital television, a digital set-top box, and Internet appliance, or the like. The editing system (100) may be configured to accept inputs from a variety of inputs including analog (116) or digital (142) cameras or camcorders, analog or digital satellite signals (102), analog or digital cable signals (104), analog or digital broadcast signals (106) received via an antenna, and Internet signals (120) received via modem, ISDN, xDSL, cable modem and the like (122). Depending on the configuration, the system may include one or more transceivers (110), analog converters (308) and decoders (304), cable modems (310), decompressors (320, 322), processors (124, 324), codecs (210, 212, 224) and encoders (140, 330). The editing system may include a media processor (130), which may be a single chip or a chip set, a memory (132) and a storage (134), such as a hard disk drive. The editing system may be integrated onto a set-top box circuit board, added to the circuitry of a television, added to an Internet appliance, and so forth. The output signals include video (330), audio (332) and data (334), and may be presented to a user on an analog (146) or digital (144) television, an analog or digital camera or camcorder, or other media recording device (148). The editing system utilizes a graphical user interface (GUI) to obtain commands for preforming the editing operations and includes a software program that receives the commands from the user. The editing system edits the received inputs according to the received commands where the editing operations may include fades, dissolves, wipes or animated effects.



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NON-LINEAR MULTIMEDIA EDITING SYSTEM INTEGRATED INTO A TELEVISION, SET-TOP BOX OR THE LIKE

Background of the Invention

Field of the Invention

The present invention relates non-linear multimedia editing. More specifically, it relates to integrating a non-linear multimedia editor into a television, set-top box, Internet appliance or the like.

Description of the Related Technology

There are approximately 140 million camcorders in the world today as reported in "Emerging Technology Report", EE Times, April 1996. Approximately 12 million new camcorders sell every year according to Dataquest, September 1996. It is believed that the average camcorder owner captures special events, such as birthdays, holidays, and sporting events and other of life's milestones, to share with friends and family and for posterity sake. In spite of all of the activity taking place at the consumer level with video capture, there are no compelling solutions that enable users to electronically edit and enhance this video for keepsake, or to share it instantly (or within hours of its capture) with friends and family. An example of when this "instant sharing" of multimedia information would be a young family sending an edited 15 or 20 second video clip of their child's first steps to the child's grandparents via electronic mail.

Digital video editing on a computer workstation, or personal computer, has evolved as a commonplace activity for professionals creating content for film, television, video games, training and marketing videos. Manufacturers of these products have attempted to extend their product lines to the consumer by selling personal computer add-on hardware and software. The problem with this solution is the user must own a computer or be willing to purchase one. Once purchased, the user must purchase the necessary hardware and software add-on components for editing. The consumer must also ensure that personal computer has enough memory and a hard drive that can sustain video data rates. In spite of the fact consumer surveys have shown that consumers typically do not add on components, particularly internal hardware components, to their personal computers (PCs), the PC is not an ideal solution even if they were willing to go through the aforementioned steps. The reason the PC is a poor solution for home video editing and communication is due to its location which is not typically close enough to the television to connect to the VCR, its lack of bandwidth for emailing data intensive video, and its cost.

The need for a PC, the lack of proximity to the VCR for those who have a PC and the complexity of integrating a video editing system have contributed to a lack of solutions in this area for the consumer. According to Griffin Dix Research, it is estimated that 17 million Americans have a computer and a video camera. Of those American households, on average, each household has approximately twenty videotapes that are unedited (raw footage). These households are unwilling to spend thousands of dollars to upgrade their computers to integrate a video editing system. Proximity to the VCR is important because users would not only wish to edit new videotape captured

on their camcorder, but they would also want to edit video footage already stored on VHS tape. Finally, once videotape has been edited, the user would need to record the edited footage back to VHS tape for storage. The user would thus need to connect their VCR to their PC to accomplish any of the basic steps of editing.

One of the main purposes of capturing videotape is to share experiences with friends and family. Families can communicate in a variety of ways today: telephone, telegraph, mail or electronic mail. Although the quality is still quite poor, video telephones, which are gaining in popularity, add the feature of seeing the person you are speaking with. Videophones do not solve the problem of showing the recipient events that happen outside the view of the videophone camera or which happened at any time other than the time of the phone call. Videotape does allow the user to share experiences, but the footage must first be edited and compressed in order to make it aesthetically pleasing, and in order to transmit it electronically.

Summary of the Invention

One aspect of the invention includes a television receiver including a digital non-linear media editor, the receiver comprising a receiver section configured to receive at least one media signal, a media editor configured to receive the media signal, wherein the media editor enables editing operations on the at least one media signal and provides an edited output signal, and a codec receiving the edited output signal and generating a video output signal based thereon.

An additional aspect of the invention includes a television system including a digital non-linear media editor, the system comprising a video input circuit configured to receive video signals and digitizing the video signals, a media editor in data communication with the video input circuit, the media editor configured to receive the digitized video signals, wherein the media editor permits manipulation of at least one of the received signals, and a video encoder receiving an output signal of the media editor and generating an analog video output signal.

Another aspect of the invention includes a system including a non-linear editor, the system comprising an audio/video input circuit configured to receive audio and video signals and digitizing the audio and video signals, a transceiver configured to receive at least one multimedia signal and demodulating the multimedia signal, a decompressor connected to the transceiver and configured to receive and decompress the demodulated multimedia signal, and a media editor connected to the audio/video input circuit and the decompressor, the media editor configured to receive the digitized audio and video signals and the decompressed multimedia signal, wherein the media editor enables editing operations on at least one of the received signals.

Yet another aspect of the invention includes a digital television system including a non-linear media editor, the system comprising an audio/video input circuit configured to receive audio and video signals and digitizing the audio and video signals, a transceiver configured to receive at least one multimedia signal and demodulating the multimedia signal, a decompressor connected to the transceiver and configured to receive and decompress the demodulated multimedia signal, and a media editor connected to the audio/video input circuit and the decompressor, the media editor

configured to receive the digitized audio and video signals and the decompressed multimedia signal, wherein the media editor enables editing operations on at least one of the received signals.

One more aspect of the invention includes a system including a non-linear editor, the system comprising an audio/video input circuit configured to receive audio and video signals and digitizing the audio and video signals, a network interface circuit configured to receive at least one media signal, a central processing unit (CPU) in data communication with the network interface circuit and configured to receive the media signal, and a media editor in data communication with the audio/video input circuit and the CPU, the media editor configured to receive the digitized audio and video signals and the media signal, wherein the media editor enables editing operations on at least one of the received signals.

Yet one more aspect of the invention includes a system including a non-linear editor, the system comprising a network interface circuit configured to receive at least one media signal, a central processing unit (CPU) connected to the network interface circuit and configured to receive the media signal, a cable modem configured to receive at least one multimedia signal and demodulating the multimedia signal, a decompressor connected to the cable modem and configured to receive and decompress the demodulated multimedia signal, and a media editor connected to the CPU and the decompressor, the media editor configured to receive the media signals and the decompressed multimedia signal, wherein the media editor enables editing operations on at least one of the received signals.

Brief Description of the Drawings

Figure 1 is a block diagram of one embodiment of a digital editing set-top Internet appliance of the present invention.

Figure 2 is a block diagram of the multimedia processor shown in Figure 1.

Figure 3 is a block diagram of one embodiment of a set-top system showing components that are added to an existing set-top box architecture.

Detailed Description of the Preferred Embodiments

The following detailed description of the preferred embodiments presents a description of certain specific embodiments of the present invention. However, the present invention can be embodied in a multitude of different ways as defined and covered by the claims. In this description, reference is made to the drawings wherein like parts are designated with like numerals throughout.

The first digital television broadcasts (DTV and HDTV) occurred on November 1, 1998 in the United States. Digital television may utilize a set-top box, which acts as the receiver and supports a host of other feature sets, such as email, Web browsing and video-on-demand, to name a few. These set-top boxes will contain both a hard drive and a cable modem for high bandwidth email and Internet connections. Future digital televisions may incorporate a set-top box or the components of a set-top box into the enclosure of the television.

The invention is directed to a sub-system that enables users to digitize, edit, enhance and communicate multimedia information through a set-top box or a digital or analog television having the components of the set-top box. One embodiment of the invention consists of a system-chip or chip set and software solution that is designed into a set-top box motherboard.

Other digital non-linear editing systems consist either of an all software solution that works with a video capture device, or a combination hardware/software solution, where the hardware consists of a video capture and edit peripheral component interconnect (PCI) add-on board. The latter system would also incorporate an audio board for audio capture, mix and edit. In both cases, the devices communicate through drivers that interface by way of the computer's operating system. A typical system will use a non-interlaced computer monitor for the graphical user interface (GUI), and which enables users to preview content in a small QuickTime® or Active Movie® windows in the RGB color space. The final production is viewed on the targeted environment, such as a television set or video monitor that is set up alongside the computer monitor, using the YUV color space or equivalent Chroma and Luma separated color space that is used by all video systems (RF, composite, S-video (Y/C), etc.).

There are several disadvantages in the way these systems are architected that make them a poor solution for a television or set-top box environment. Firstly, such systems rely on a computer monitor to display the GUI. Computers operate in the RGB color space, while video display or recording equipment operates in the YUV color space or similar space, such as YIQ, Y/C, or YCrCb. The second major impediment to incorporating a computer non-linear editing system to a television or digital set-top box is cost. These devices are consumer devices, so any added features must be cost effective. In order to support the distribution and dealer channels, any additional feature in a consumer electronics device typically results in a retail increase of 4 – 5 times the cost of that feature. Today's non-linear editing hardware systems are created on PCI add-on boards, which cannot physically, or cost-effectively be incorporated into a television or digital set-top box. Although it is expected that digital televisions or set-top boxes will incorporate hard drives, low cost hard drives will be most desirable, e.g., 5400 rpm EIDE drives versus 7200 rpm or 10000 rpm SCSI hard drives, for example.

A large amount of the functionality of computer-based video editing systems, such as video mixing and layering, resides in software. As a result, the way to increase performance is by increasing the microprocessor power of the system – adding a more powerful processor or multiple processors – or to add an additional video data stream and mixing IC (integrated circuit) to increase the speed of video mixing. Adding an extra data stream requires a second compression IC and either a second hard drive or an A/V rated hard drive in order to support both streams. Again, not only is cost a key concern with a consumer electronics device such as a television or a digital set-top box, but physical space is also extremely limited in these devices. Adding additional components to increase performance will increase cost if there is even room for such additional components. Finally, because computer-based editing systems rely on extensive software programming, a large amount of hard drive disk space is required to support the program applications. A popular computer-based application such as Adobe Premiere, for instance, uses 32 MB of RAM and 60

MB of hard disk space as minimum system requirements (Adobe Premiere 5.0 User Guide, 1998). Memory will be a premium on digital televisions and set-top boxes.

The present invention overcomes the limitations of existing non-linear editing systems as pertains to consumer use. The invention is designed to integrate with a platform that is optimized for video input/output over the Internet, such as may be embodied in a television (analog or digital) or a set-top box. Other manufacturers have created editing systems with software and off-the-shelf components integrated to PCI add-on boards for computers. The invention may include an editing system-on-a-chip or a reduced chip set for real-time video editing, either of which may be used as a Multimedia Processor (MP). In one embodiment, the MP has its own processor on board and represents an audio/video mixing and graphics effects engine. The MP also incorporates functionality that normally resides in software in other editing systems. Thus, the MP can be considered to be a multimedia or media editor and may also be referred to as the media editor section. As a result, high-end performance – defined as real-time editing, transitions and 2D effects – is achieved without the need for fast, or multiple, microprocessors, and without the need for a high-end hard drive. The system-chip solution, which may be ¾ inches square, overcomes the physical constraints in these consumer products as well as the cost issues – the complete solution is relatively inexpensive. A comparable PC-based solution may retail for between $2,500 to $10,000, not including the computer – video board, audio board and software only. Low-end consumer targeted PC-based editing solutions retail from as low as $200 to $1,000, not including the computer.

Additionally, the Multimedia Processor enables the inventive editing application to be far smaller than computer-based editing systems by limiting the operating system and application requirements to just those of video editing, rather than a generalized computer system. The software application for the invention, which takes up approximately 900K of memory, resides in read only memory (ROM) on the MP, so no hard drive space is required. If the hard drive were to crash, the application would continue to work – simply telling the user to replace the faulty drive. There would be no system crash. In one embodiment, the MP onboard processor is a slave to the television or set-top box's processor for all functions but editing, in which case it becomes the master. This architecture enables the MP to be incorporated to a variety of set-top boxes regardless of the native processor. Finally, the system, including GUI, may operate entirely in the YUV color space, which is ideal when using video equipment for display or tape storage. The GUI enables the user to switch between a scaled down view of the video content (e.g., in the upper right-hand corner of the display) while using system functions, and a full-screen preview of their video production when focusing on the aesthetics of the final project. The unique feature in the GUI being that the user uses the target environment – the television screen – as both the workspace and the preview space, thus avoiding the need for a second monitor. In summary, the invention includes a cost-effective chip-set-with-software solution that is targeted toward the consumer/living room environment, and which can be easily incorporated into a variety of televisions or digital set-top boxes.

Referring to Figure 1, an exemplary top-level block diagram of a set-top box system 100 designed for editing for video, audio, and Internet content will be described. An external audio/video (A/V) source 116 (baseband) may be,

for example, a VCR, laserdisc player, DVD player or some other baseband video source one would find in a home. Support for existing home entertainment analog inputs is not provided in tradition set-top box configurations that are normally solely for the purpose of converting digital content (satellite or web) so it can be displayed on an analog television display. The signals for this interface may be, for example, composite video, Y/C video (S-video), and stereo audio. An A/V input circuit 118 contains, for example, circuits for terminating, buffering, amplifying and digitizing the incoming video and audio. The A/V input circuit puts out CCIR601 digital video and a digital audio format on a signal line 119. Of course, other formats and standards such as CCIR656 could be used. By digitizing video and audio at circuit 118, the system can handle all source material (such as from an analog VCR 116 or a satellite dish 102) in one common format necessary for mixing and editing by the Multimedia Processor 130.

A transceiver 110 may encompass down-conversion, demodulation, synchronization extraction, forward error correction and, if necessary, decryption. The transceiver 110 includes a receiver section 112 and a transmitter section 114. A decompress block is used for a data stream received by the receiver section 112 which is compressed at the source and so must be decompressed using the same method at the set-top box. Decompressed inputs are also converted to the one common mixing format used throughout the system. Data streams that are not compressed at the source bypass the decompression operation and are forwarded via signal line 129 in audio and video signal paths to the multimedia processor 130. The multimedia processor 130 is implemented, in one embodiment, as a custom System-On-a Chip (SOC) device. An A/V output circuit 140 processes the output signals of the multimedia processor 130 to drive an output device, such as an analog television 146 or VCR 148, or a digital television (DTV) 144, camera 142, or other digital recording device. The addition of a Hard Disk Drive 134 to the model of the set-top box via control of the media processor allows for high performance storage and recall of media (for editing, playback and recording purposes) and prevents the consumption of time on the CPU Bus 125 and on the CPU 124 itself. The main components storage 134, memory 132, multimedia processor 130, and input circuit 118 are the novel features that change a passive viewing-only set-top box (e.g., web browser, satellite receiver) into a digital editing appliance.

Further descriptions for specific components of Figure 1 are as follows:

Transceiver 110 (Receiver Section 112 and Transmitter Section 114)

The transceiver 110, which includes receive 112 and transmit 114 capabilities, has a tuner, modulator and demodulator, FEC and transport all in one block. This tuner can take an antenna or cable signal as input. This set-top box will also be able to receive off-the-air signals as input. The cable interface is shown as being bi-directional to connect the set-top box to the Internet or other communications network. The set-top box system can be used to create videos and format them for bandwidth efficient transmission over the Internet. Cable tuners are widely available now. Statistics from the Yankee group show that sales in the home networking space will reach $1 billion by the year 2002. The output of the data demodulator is a serial digital data stream. FEC, Transport Processor and Access Control: The input to the FEC is a digital data stream that may have errors in it. The output of the FEC is a data stream that has been error corrected. If the data stream has errors that were not correctable the FEC will provide a signal that

indicates which blocks of data have the errors in it so that some sort of error concealment algorithm may be employed. The input to the transport processor block is the error corrected data stream. This block parses out the various data multiplexes (video, audio and data) for further processing. It also has an access control element within it for decryption of data.

Internet Interface Circuits 122

The Internet interface circuits 122 could support Ethernet, plain old telephone service (POTS), xDSL, ISDN via a modem, cable modem or other appropriate interface circuitry. A variety of interface standards may be utilized and supported.

Multimedia or Media Processor (MP) 130

Applied Magic has a chip called Grimoire that serves as the Multimedia or Media Processor (MP) on our current generation of the non-linear multimedia editing system (ScreenPlay). An enhanced version of the Grimoire chip is described more fully in Figure 2, "Multimedia Processor Block Diagram". Various formats for the digital media signal may be used. In one embodiment, the MP utilizes signals in the CCIR-656 format. Other embodiments may use signals in other formats, such as CCIR-601. In one embodiment, SDRAM memory is connected to the MP. The memory may be 32 MB to 128 MB such as available from Hitachi, Hyundai, and other vendors.

Storage 134

The storage 134 represents a generic storage device, such as an EIDE (U-ATA) type of Hard Disk Drive (HDD). Other potential choices may include any mass storage device capable of sustained data transfer rates up to 3 Megabytes/second. Optical storage may be an option when the data rates improve.

DV Physical Layer and Link Layer Circuit 138

The DV physical layer and link layer circuit 138 shows the bi-directional DV/IEEE 1394 interface on this Set-top Appliance. This circuit 138 shows an optional DV/1394 interface for the Multimedia Processor 130. In one embodiment, with the optional DV codec hardware 224 in the MP 130, a Link Layer and Physical Layer (PHY) circuit 138 is needed externally to complete the interface. With a faster System CPU 124, e.g., such as faster than 200 MHz, it may be possible to do the codec in software. In that case, the DV Link Layer and PHY circuit 138 would connect to the local CPU bus 125. Example components include the Texas Instruments (TI) physical layer chip TSB41LV03PFP and the TI link layer chip TSB12LV42PZ.

The multimedia processor (MP) 130 is further described and shown in Figure 2. Central to the multimedia processor 130 is the Enhanced Multimedia Processing Engine 200 that has been described in co-pending patent applications: U.S. Application No. 08/906,589, entitled "Non-Linear Editing System for Home Entertainment

Environments", filed August 5, 1997, and U.S. Application No. 08/906,304, entitled "Media Editor for Non-Linear Editing System", filed August 5. This engine 200 performs all the real-time mixing of multiple channels of video and audio so as to perform operations such as fades, dissolves, wipes, titles, graphics overlay or animated effects. To enhance this existing engine as part of the multimedia processor 130, support is added for internally compressed video material via codec 210 and optional second codec 212. Support is also added for storage via a hard disk controller 220 on drive 134 which permits the multimedia processor 130 to operate with very little intervention from the CPU 124 and very little load on the bus 125. This is highly important for real-time video/audio editing within a set-top box design).

To maintain high throughput within the multimedia processor 130 without major CPU 124 intervention, a DMA controller 218 handles all the moving of compressed or uncompressed media data between the memory 132 and all internal components of the multimedia processor. In one embodiment, all editing, DMA, effects, storage, playback, titles and mixing operations are setup and controlled by a set of registers 222; the setup of these registers is the minimal level of intervention required by the host CPU 124. This means the host CPU 124 can have low processing power and therefore low cost, whereas traditional video editing technique require high processing power, and is a major concern for set-top box development. The multimedia processor 130 may include a digital video (DV) codec core 224 to support DV IEEE 1394 digital video equipment commonly used in consumer camcorders and other digital devices. By adding the DV codec 224, this decompression stage can be off-loaded from the CPU 124. The DV signal may be input to the media processor 130 from the digital camera 142 via signal line 141, through the DV circuit 138 and onto signal line 119.

The MP may be a System-On-a-Chip (SOC) incorporating the Enhanced Multimedia Processing Engine, e.g., the Grimoire ASIC, and other circuitry, or it may be a chip set. Further descriptions for specific components of Figure 2 are as follows:

Video Compression/Decompression Core 210

The video compression / decompression (codec) core 210 represents a generic method for video compression and decompression consisting of the engine and some memory. In one embodiment, wavelet compression is used, but other compression approaches may be used in other embodiments for maximizing efficiency while minimizing gate count. Two compression blocks are shown in Figure 2, where the second compression /decompression core 212 is optional in one embodiment of the MP. The second core block 212 would allow dual stream real-time (60 fields per second) effects and transitions.

Enhanced Multimedia Processing Engine 200

The enhanced multimedia processing engine 200 represents a video and audio mixing engine that allows single stream real time effects and transitions, e.g., the Grimoire ASIC. With the optional second compression core 212, dual stream real-time effects and transitions are achieved. The engine 200 requires external SDRAM 132 to perform its functions.

Host CPU Interface 216

The host CPU interface 216 indicates logic on this SOC 130 to interface to the main System CPU 124. In one embodiment, the System CPU 124 is a model 403GCX-66 PowerPC available form IBM, but other System CPUs may be used in other embodiments, depending on various factors such as price versus performance and availability, etc.

DMA Controller 218

The DMA controller 218 shows the logic on this SOC 130 to help manage the bursty data transfers that are necessary to achieve best utilization of available system bandwidth.

HDD Interface Controller 220

The HDD interface controller 220 represents the control logic necessary to support high data rate transfers between the local processor bus and a hard disk drive, such as using the EIDE format. The EIDE format is fast and cost effective. Other fast and cost effective formats are envisioned and may be used in other embodiments.

Control and Status Registers 222

The control and status registers 222 represent new writeable control registers and readable status registers within the multimedia processor. Example registers include registers to enable advanced features related to Chroma key.

Digital Video (DV) Codec 224 (Optional)

An example DV codec is the NW701 from Divio.

Figure 3 shows further details and/or variations of the top level system block diagram of Figure 1. A system 300 shown in Figure 3 provides many of the same set-top features of the system 100 shown in Figure 1 except that the cable signal (analog or digital) 104 and cable modem 310 are the primary sources for the traditional set-top features (television viewing and web browsing). The additional components of video input buffers and muxes 302, video decoder 304, multimedia processor 130, memory 132, storage 134, audio input buffers 306, and audio analog-to-digital converters 308 turn the passive set-top box into a real-time editing system. As an editing system, data paths 341 and 343 enable edited media content to be transmitted via the cable modem 310 and cable 104 out to the Internet for world wide accessibility. So, in addition to this set-top box being able to produce edited media for television or video tape delivery, the same content can be compressed by the multimedia processor 130 or the CPU 124 into an Internet ready media format for delivery to the web (WWW).

Further descriptions for specific components of Figure 3 are as follows:

Analog Input Sections 302, 304, 306, 308

The four blocks 302, 304, 306, 308 represent the video and audio analog input sections. This allows people to import video and/or audio from commonly available devices at home, e.g., VCRs, camcorders, etc.

Cable Modem 310

The cable modem module 310 is shown as a bi-directional cable modem. Its purpose is to provide high speed digital communication between the set-top box and the outside world. Cable modems are well known and available from many vendors. The cable modem includes three sections:

A) A modem, which is a cable tuner and a data demodulator: The input to the tuner is a radio frequency (RF) signal. The output of the demodulator is a serial digital data stream.

B) The forward error correction (FEC) section: The input to the FEC is a digital data stream that may have errors in it. The output of the FEC is a data stream that has been error corrected. If the data stream has errors that were not correctable, the FEC provides a signal that indicates which blocks of data have the errors in it so that some sort of error concealment algorithm may be employed.

C) Transport processor with access control: The input to this section is the error corrected data stream. This section parses out the various data multiplexes (video, audio and data) for further processing. It also has an access control element within it for decryption of data.

Video Decompress Processor 320

This block is an MPEG video decompression processor 320. This block is intended to represent the industry standard technology for this function. Example components are DV Express available from C-cube and AVI available from General Instrument.

Audio Decompress Processor 322

The audio decompression processor 322 can utilize AC/3, MUSICAM or any other audio compression (decompression) standard. Example components include an MPEG/AC3 core available from IBM and AC3 chips available from Zoran.

Data Channel Processor 324

All digital satellite and cable systems have auxiliary data channels. The data channel processor 324 shows a means to process and use the auxiliary data channel data.

Video Encoder 330

In one embodiment, the video encoder 330 takes CCIR-656 video and converts it to analog format. It has composite and Y/C outputs. An exemplary video encoder component is the model ADV7176 available from Analog Devices.

Audio DAC and volume control 332

The audio DAC and volume control 332 takes digital audio from the multimedia processor and converts it to analog of the proper level. An exemplary component is the AKM 4531.

Data Interface Circuits 334

The data interface circuit 334 could be a USB, RS-422 or some other standard data interface circuit. USB has the advantage of being bi-directional, whereas RS-422 would be one way (output only).

FEATURES AND ADVANTAGES

- System-chip solution eliminates need for PCI slots, which televisions or set-top boxes won't have and could not cost-effectively integrate.
- System-chip technology – all of the benefits offered by a Media Editor in two co-pending patent applications: U.S. Application No. 08/906,589, entitled "Non-Linear Editing System for Home Entertainment Environments", filed August 5, 1997, and U.S. Application No. 08/906,304, entitled "Media Editor for Non-Linear Editing System", filed August 5, 1997, both of which are hereby incorporated by reference.
- Dedicated video editing technology requires low demand on memory – both for use and for storing application (e.g., 900K file size versus 30 MB and more for computer-based systems).
- Unique form factor – incorporation into a television or digital set-top box is unique as all existing digital non-linear editing systems are built around personal computers.
- The Media Editor may be combined with a set-top box cable modem.
- The Media Editor may be combined with a cable television feed.
- The Media Editor may be combined with a broadcast digital television tuner.
- The Media Editor may be combined with a broadcast television tuner.
- The Media Editor may be combined with a satellite (analog or digital) feed.
- The Media Editor may be combined with an Internet or network feed.
- The Media Editor may be combined with an IEEE 1394 physical and link layer for IEEE 1394 input/output transmissions.

PERFORMANCE ADVANTAGES

- The Media Editor allows for real-time transitions and 2-D effects without the need for a second video data stream and codec.
- The Media Editor allows for real-time transitions and 2-D effects without the need for a second hard drive or an A/V (audio-video) rated hard drive
- The Media Editor allows for real-time transitions and 2-D effects without the need for a high-end microprocessor – system utilizes a 66 MHz PowerPC® processor versus dual 400 MHz, or greater, Pentium® (or similar) processors.
- Small application/OS profile (≈ 900K file size) and small physical size (Media Editor ASIC) allow for cost-effective integration to consumer devices, such as set-top boxes.

The present invention may be integrated into a personal video recorder such as those offered by Tivo, Replay and others. The invention may also be realized by integration with Internet interfaces such as those used with WebTV.

Specific blocks, sections, devices may have been set forth. However, a skilled technologist will realize that there are many ways to partition the system of the present invention, and that there are many parts or components that may be substituted for those listed above.

While the above detailed description has shown, described, and pointed out the fundamental novel features of the invention as applied to various embodiments, it will be understood that various omissions and substitutions and changes in the form and details of the system illustrated may be made by those skilled in the art, without departing from the intent of the invention.

WHAT IS CLAIMED IS:

1. A television receiver including a digital non-linear media editor, the receiver comprising:

a receiver section configured to receive at least one media signal;

a media editor configured to receive the media signal, wherein the media editor enables editing operations on the at least one media signal and provides an edited output signal; and

a codec receiving the edited output signal and generating a video output signal based thereon.

2. The receiver defined in Claim 1, additionally comprising a transmitter section capable of transmitting digital signals, the transmitter section receivably connected to the media editor.

3. The receiver defined in Claim 2, wherein the receiver section and the transmitter section are integrated into a transceiver.

4. The receiver defined in Claim 1, additionally comprising a television display for displaying at least the video output signal.

5. The receiver defined in Claim 1, wherein the at least one media signal comprises an Internet signal.

6. The receiver defined in Claim 1, wherein the at least one media signal comprises a digital television signal.

7. The receiver defined in Claim 6, wherein the digital television signal is received by a satellite dish.

8. The receiver defined in Claim 6, wherein the digital television signal is received by an antenna.

9. The receiver defined in Claim 1, wherein the receiver section includes a tuner.

10. The receiver defined in Claim 3, wherein the transceiver includes a modem.

11. The receiver defined in Claim 3, wherein the transceiver includes a forward error correction circuit and a transport processor.

12. The receiver defined in Claim 1, additionally comprising a decompressor receivably connected to a digital signal output of the receiver section for decompressing at least a video portion of the digital signal.

13. The receiver defined in Claim 12, wherein the decompressor decompresses an audio portion of the digital signal.

14. The receiver defined in Claim 1, wherein the codec generates an audio output signal.

15. The receiver defined in Claim 1, wherein the editing operations include fades, dissolves, wipes, animated effects, titling, or graphics overlay.

16. The receiver defined in Claim 1, additionally comprising an analog output circuit and an analog television section, wherein the analog output circuit receives an edited output signal of the media editor.

17. The receiver defined in Claim 1, wherein the at least one media signal comprises an analog signal or a digital signal.

18. The receiver defined in Claim 1, wherein the at least one media signal is representative of a still image or a video.

19. A television system including a digital non-linear media editor, the system comprising:

a video input circuit configured to receive video signals and digitizing the video signals;

a media editor in data communication with the video input circuit, the media editor configured to receive the digitized video signals, wherein the media editor permits manipulation of at least one of the received signals; and

a video encoder receiving an output signal of the media editor and generating an analog video output signal.

20. The set-top box system defined in Claim 19, additionally comprising a television for displaying at least the analog video output signal.

21. The set-top box system defined in Claim 19, wherein manipulation of at least one of the received signals includes editing operations, such as fades, dissolves, wipes, animated effects, graphics overlay, or titling.

22. A system including a non-linear editor, the system comprising:

an audio/video input circuit configured to receive audio and video signals and digitizing the audio and video signals;

a transceiver configured to receive at least one multimedia signal and demodulating the multimedia signal;

a decompressor connected to the transceiver and configured to receive and decompress the demodulated multimedia signal; and

a media editor connected to the audio/video input circuit and the decompressor, the media editor configured to receive the digitized audio and video signals and the decompressed multimedia signal, wherein the media editor enables editing operations on at least one of the received signals.

23. The system defined in Claim 22, additionally comprising a memory connected to the media editor.

24. The system defined in Claim 23, wherein the memory stores video frames for editing by the media editor.

25. The system defined in Claim 22, additionally comprising a mass storage connected by a local bus to the media editor, the decompressor and the transceiver.

26. The system defined in Claim 22, additionally comprising a video encoder receiving an output signal of the media editor, the video encoder generating an analog video output signal.

27. The system defined in Claim 26, additionally comprising a display device for display of the analog video output signal.

28. The system defined in Claim 27, wherein the display device comprises an analog television set.

29. The system defined in Claim 27, wherein the media editor utilizes a graphical user interface (GUI) to obtain commands for performing the editing operations.

30. The system defined in Claim 29, wherein the display device concurrently displays both the analog output signal and the GUI.

31. The system defined in Claim 22, wherein the media editor includes a software program receiving commands from a user, and wherein the media editor edits the received inputs according to the received commands.

32. The system defined in Claim 22, additionally comprising a codec receiving an output signal of the media editor, the codec generating an encoded output signal.

33. The system defined in Claim 32, additionally comprising a digital television for playback of the encoded output signal.

34. The system defined in Claim 22, wherein the editing operations include fades, dissolves, wipes, animated effects, graphics overlay or titling.

35. A digital television system including a non-linear media editor, the system comprising:

an audio/video input circuit configured to receive audio and video signals and digitizing the audio and video signals;

a transceiver configured to receive at least one multimedia signal and demodulating the multimedia signal;

a decompressor connected to the transceiver and configured to receive and decompress the demodulated multimedia signal; and

a media editor connected to the audio/video input circuit and the decompressor, the media editor configured to receive the digitized audio and video signals and the decompressed multimedia signal, wherein the media editor enables editing operations on at least one of the received signals.

36. The system defined in Claim 35, additionally comprising a codec receiving an output signal of the media editor and generating a compressed output signal.

37. The system defined in Claim 36, additionally comprising output devices for playback of the compressed output signal.

38. The system defined in Claim 37, wherein the output devices include a display device and a sound reproduction device.

39. The system defined in Claim 38, wherein the media editor utilizes a graphical user interface (GUI) to obtain commands for performing the editing operations.

40. The system defined in Claim 39, wherein the display device concurrently displays both the compressed output signal and the GUI.

41. The system defined in Claim 35, wherein the media editor includes a software program receiving commands from a user, and wherein the media editor edits the received inputs according to the received commands.

42. The system defined in Claim 35, wherein the editing operations include fades, dissolves, wipes, animated effects, titling or graphics overlay.

43. A system including a non-linear editor, the system comprising:

an audio/video input circuit configured to receive audio and video signals and digitizing the audio and video signals;

a network interface circuit configured to receive at least one media signal;

a central processing unit (CPU) in data communication with the network interface circuit and configured to receive the media signal; and

a media editor in data communication with the audio/video input circuit and the CPU, the media editor configured to receive the digitized audio and video signals and the media signal, wherein the media editor enables editing operations on at least one of the received signals.

44. The system defined in Claim 43, additionally comprising a mass storage in data communication with the media editor.

45. The system defined in Claim 43, additionally comprising a video encoder receiving an output signal of the media editor, the video encoder generating an analog video output signal.

46. The system defined in Claim 45, additionally comprising a display device for display of the analog video output signal.

47. The system defined in Claim 46, wherein the display device comprises a television set.

48. The system defined in Claim 46, wherein the media editor utilizes a graphical user interface (GUI) to obtain commands for performing the editing operations.

49. The system defined in Claim 48, wherein the display device concurrently displays both the analog output signal and the GUI.

50. The system defined in Claim 43, wherein the media editor includes a software program receiving commands from a user and wherein the media editor edits the received inputs according to the received commands.

51. The system defined in Claim 43, additionally comprising a digital video module receiving an output signal of the media editor, the digital video module generating a digital video format output signal.

52. The system defined in Claim 51, additionally comprising a digital display device for playback of the digital video format output signal.

53. The system defined in Claim 43, wherein the editing operations include fades, dissolves, wipes or animated effects.

54. The system defined in Claim 43, wherein the media signal includes a digital video signal.

55. A set-top box system including a non-linear editor, the system comprising:

a network interface circuit configured to receive at least one media signal;

a central processing unit (CPU) connected to the network interface circuit and configured to receive the media signal;

a cable modem configured to receive at least one multimedia signal and demodulating the multimedia signal;

a decompressor connected to the cable modem and configured to receive and decompress the demodulated multimedia signal; and

a media editor connected to the CPU and the decompressor, the media editor configured to receive the media signals and the decompressed multimedia signal, wherein the media editor enables editing operations on at least one of the received signals.

56. The system defined in Claim 55, wherein the media signal includes a digital video signal.

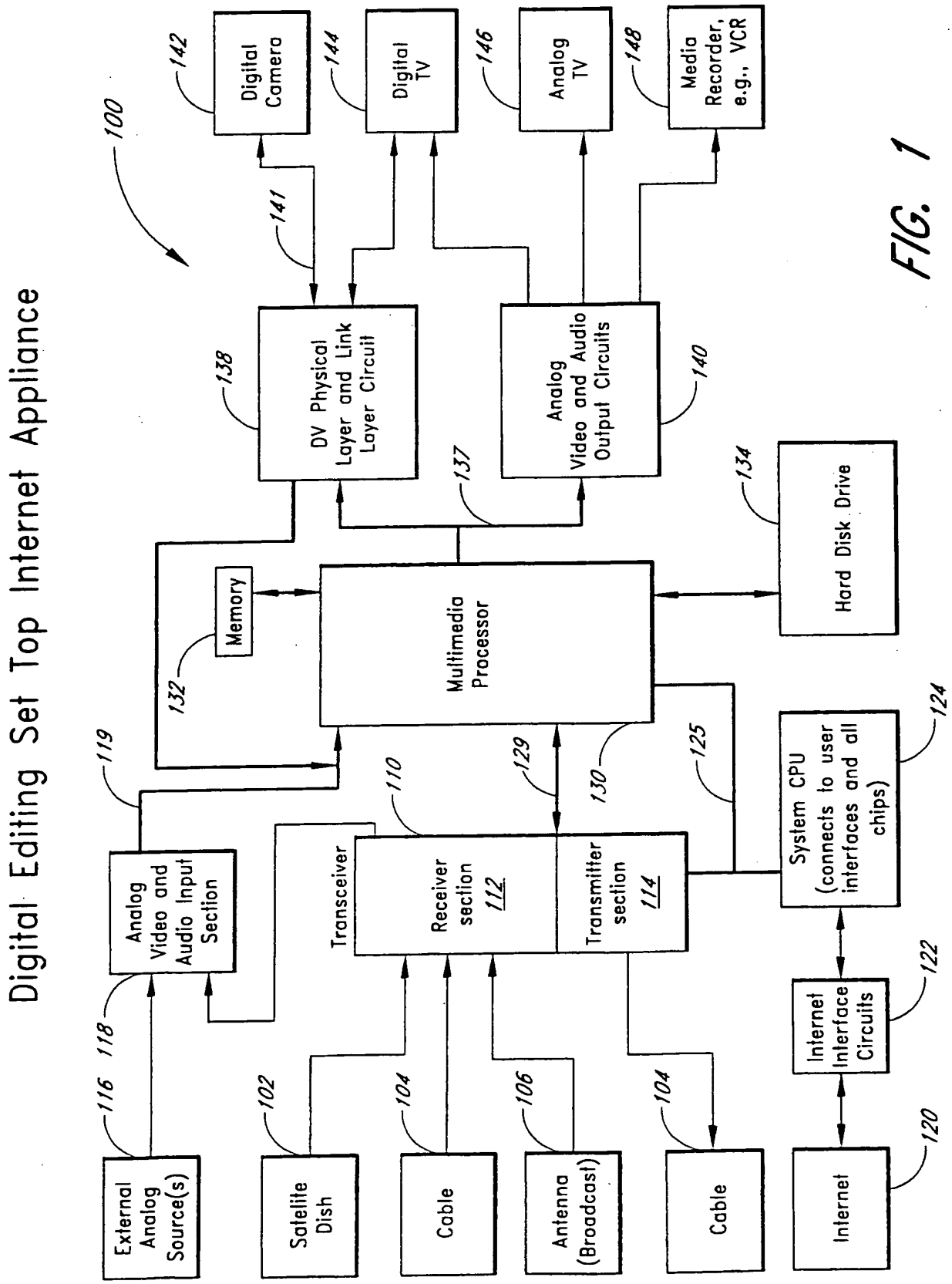

Digital Editing Set Top Internet Appliance
100
Digital Camera
142
Digital TV
144
Analog TV
146
Media Recorder, e.g., VCR
148
141
DV Physical Layer and Link Layer Circuit
138
Analog Video and Audio Output Circuits
140
137
Hard Disk Drive
134
Memory
132
Multimedia Processor
119
110
129
130
125
124
System CPU (connects to user interfaces and all chips)
Analog Video and Audio Input Section
Transceiver
Receiver section 112
Transmitter section 114
Internet Interface Circuits
122
116
118
102
104
106
104
120
External Analog Source(s)
Satellite Dish
Cable
Antenna (Broadcast)
Cable
Internet

FIG. 1

FIG. 2

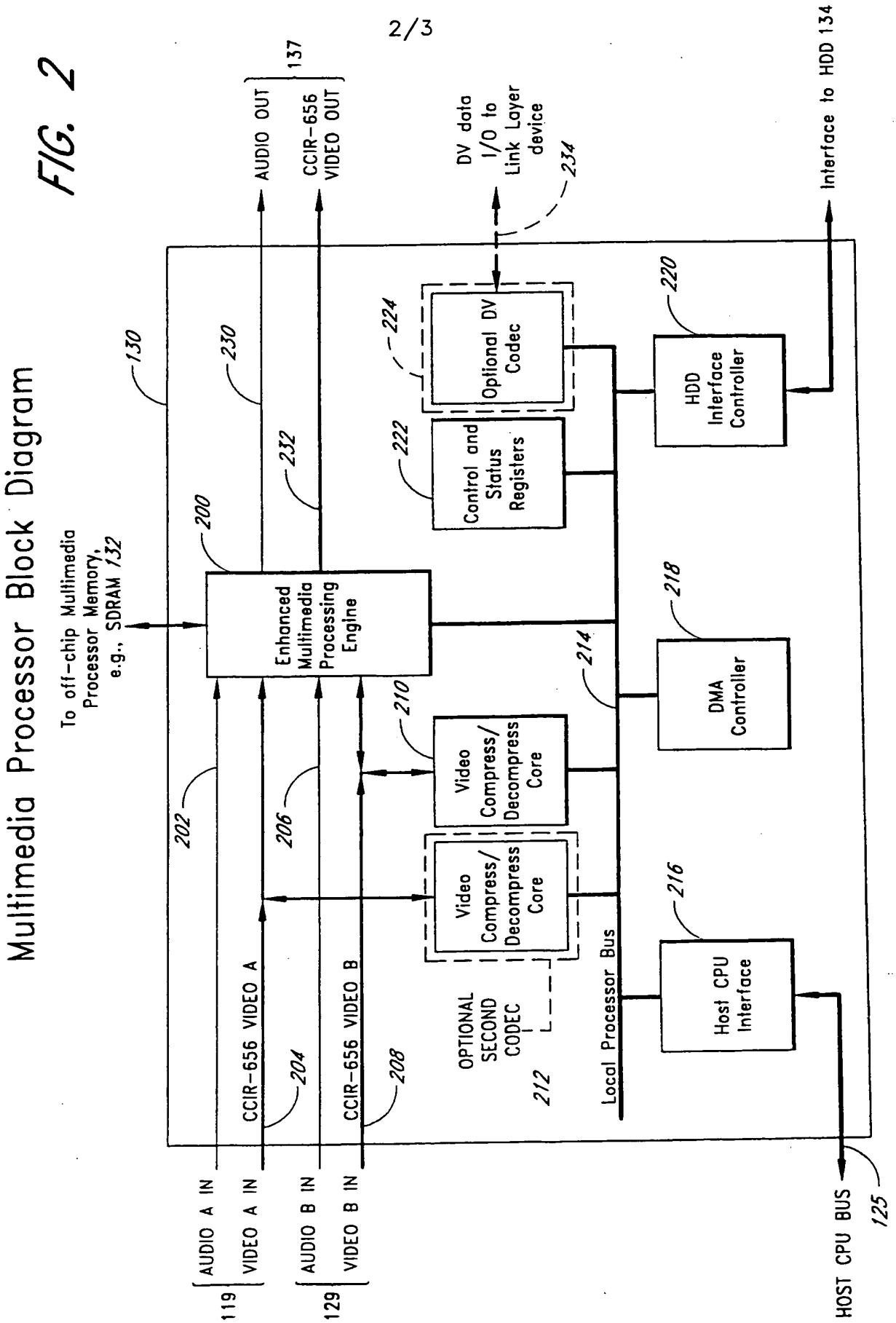
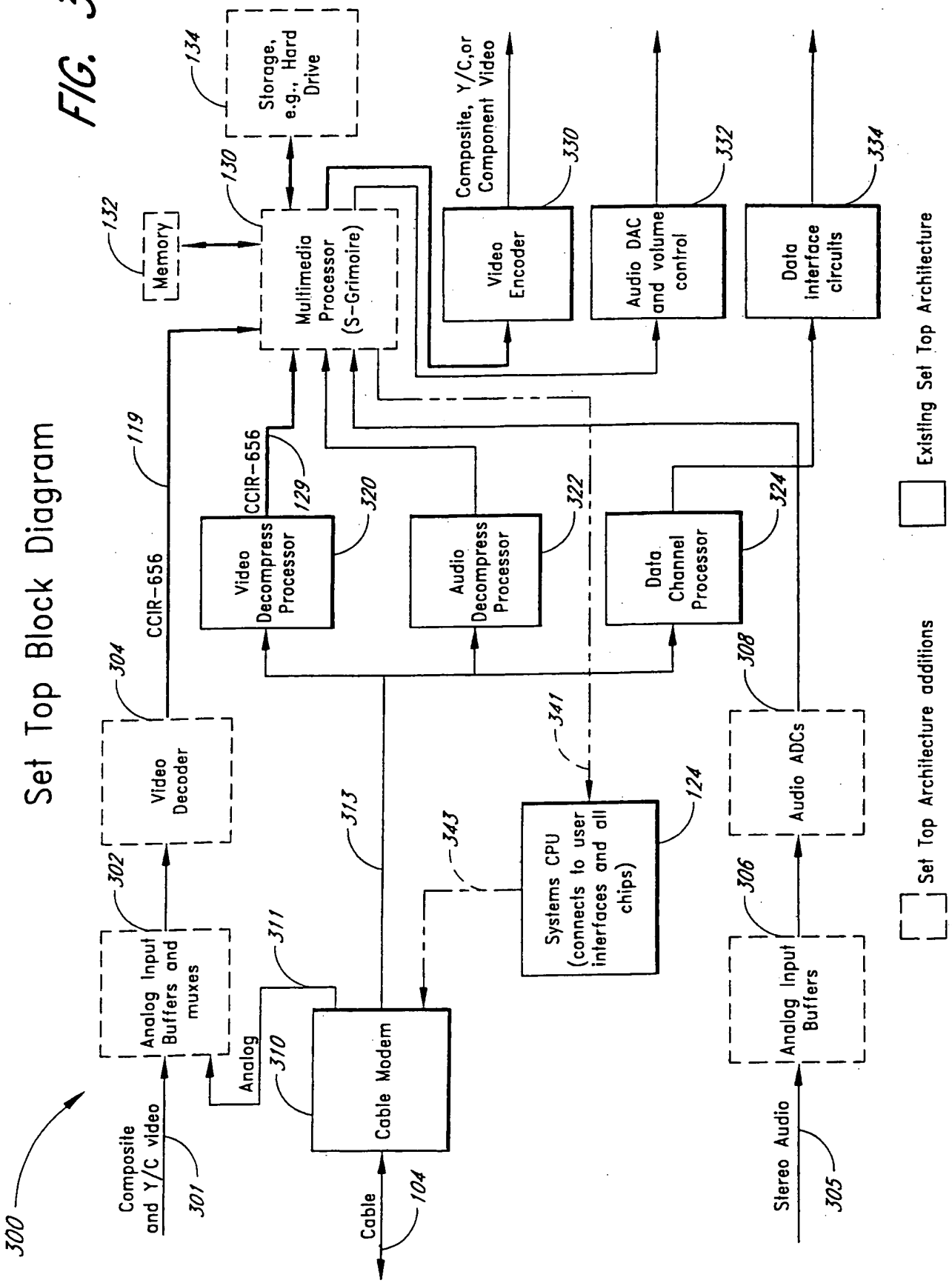

Multimedia Processor Block Diagram
To off-chip Multimedia Processor Memory, e.g., SDRAM 132
130
Enhanced Multimedia Processing Engine
200
AUDIO OUT
CCIR-656 VIDEO OUT
137
230
232
DV data I/O to Link Layer device
234
Optional DV Codec
224
Control and Status Registers
222
HDD Interface Controller
220
Interface to HDD 134
DMA Controller
218
214
Video Compress/ Decompress Core
210
Video Compress/ Decompress Core
OPTIONAL SECOND CODEC
212
Local Processor Bus
Host CPU Interface
216
202
206
204
208
CCIR-656 VIDEO A
CCIR-656 VIDEO B
AUDIO A IN
VIDEO A IN
AUDIO B IN
VIDEO B IN
119
129
HOST CPU BUS
125

FIG. 3


Set Top Block Diagram
300
Composite and Y/C video
301
Analog Input Buffers and muxes
302
Video Decoder
304
CCIR-656
119
Analog
310
311
Cable Modem
313
Cable
104
Memory
132
Storage, e.g., Hard Drive
134
Multimedia Processor (S-Grimoire)
130
CCIR-656
129
Video Decompress Processor
320
Audio Decompress Processor
322
Data Channel Processor
324
Video Encoder
330
Composite, Y/C, or Component Video
Audio DAC and volume control
332
Data interface circuits
334
341
343
Systems CPU (connects to user interfaces and all chips)
124
308
Audio ADCs
306
Analog Input Buffers
Stereo Audio
305
Existing Set Top Architecture
Set Top Architecture additions

INTERNATIONAL SEARCH REPORT

Int .onal Application No
PCT/US 00/05053

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G11B27/034 H04N5/00 H04N5/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G11B H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 838 952 A (THOMSON BRANDT GMBH) 29 April 1998 (1998-04-29)	19-22, 25-28, 31,32, 34-38, 41-47, 50,51, 53-56
Y	the whole document	1-10, 12-18, 23,24, 29,30, 33,39, 40,48,49

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 July 2000	19/07/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Daalmans, F

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Form PCT/ISA/210 (second sheet) (July 1992)

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Y	MALCHER D ET AL: "TV-MULTIMEDIA-PC ARBEITEN, INFORMIEREN UND UNTERHALTEN OHNE GRENZEN" FERNSEH UND KINOTECHNIK,DE,VDE VERLAG GMBH. BERLIN, vol. 50, no. 3, 1 March 1996 (1996-03-01), pages 104-109, XP000581419 ISSN: 0015-0142 page 107, left column, last paragraph - middle column, line 30	1,2,4, 6-9, 12-15,18
Y	WO 98 06098 A (APPLIED MAGIC INC) 12 February 1998 (1998-02-12)	3,5,10, 29,30, 39,40, 48,49
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A	the whole document	1,2,4, 6-8, 12-15, 18,19, 22, 25-28, 30-32, 34-38, 40-46, 49-54
Y	US 5 838 876 A (IWAMURA RYUICHI) 17 November 1998 (1998-11-17) column 5, line 29 -column 6, line 16; figures 4,5	23,24
A	the whole document	1,2,4,6, 7,9,11, 16-19, 26-28, 35,38, 43,47

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INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/US 00/05053

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0 764 951 A (SONY CORP) 26 March 1997 (1997-03-26) the whole document	1,2,4,6, 17-19, 22, 25-27, 29,30, 35,39, 40, 43-46, 48,49,52
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Int[illegible]ional Application No
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